

# 2008 Alternative Fuels Challenge Guidelines

The Alternative Fuels Challenge provides an opportunity for middle school teams to develop and use applied science and engineering skills and face technical challenges comparable to those that scientists and engineers face every day. The Challenge was developed to provide a hands-on opportunity for students to understand the need for renewable energy sources and explore the emerging technology of hydrogen power. In addition to understanding how things work, engineers and scientists must think creatively and be able to communicate their findings. Middle school students from the following public school districts are invited to participate: Albuquerque, Rio Rancho, Bernalillo, Espanola, Los Alamos, ???

The **Alternative Fuels Challenge** is a **four part challenge** consisting of:

1. Car Design Challenge – challenge based on innovation (system design), technology (power-train/chassis), and craftsmanship/appearance.
2. Car Performance Challenge – challenge based on a series of head-to-head, double elimination drag races over a 10 meter course.
3. Oral Presentation Challenge – challenge based on an oral presentation addressing “What impacts, positive and negative, might hydrogen fuel technology have on our society.”
4. Essay Challenge – challenge based on an essay addressing “What impacts, positive and negative, might hydrogen fuel technology have on our society.”

Each Challenge will be scored individually and awards will be provided to the top three teams for each Category. In addition, scores for all Challenges will be totaled to determine the top three Overall winners.

## Teacher Workshop

February 9, 2008  
APS Montgomery Complex  
9-2???  
Stipend: \$75  
Lunch will be provided

Attendance at the workshop is optional. Teachers will learn about hydrogen power and car design. Participating teachers will receive an additional fuel cell car kit and training materials at the workshop. In addition, they will have the opportunity to construct and race their own car.

## Teams

- Teams consist of 2-6 middle school students

- Students in grades 6, 7, 8 are eligible to participate
- Students may elect to work on different challenges (construction, design, essay and oral presentation) – all team members do not have to work on each challenge
- Students may be required to conduct their oral presentation at the same time as a drag race – so you may need to split up your team – prepare accordingly
- A teacher from the participating school must attend the Alternative Fuels Challenge with the student team(s) on April 19, 2008.
- Each school may have a maximum of 2 teams.
- A maximum of 40 teams may participate.

## Car Construction

Each team is responsible for designing and building a hydrogen fuel cell powered model race car.

The fuel cell provided to each team enables the team to produce hydrogen using a battery pack. During the race, the hydrogen will be used to produce electricity to power the car. The motor and fuel cell provided must be used in the design. Each team may design and build the chassis, wheels and gears from any other materials that they choose.

Cars are judged on design and performance. The cars will be constructed prior to the challenge but will be inspected on challenge day to verify each team adhered to the construction requirements.

All cars will be inspected by a race official prior to the beginning of the race to ensure that they meet all vehicle specifications. Cars that meet these requirements will be given an inspection sticker that will be placed on the car. Cars that do not meet these specifications may be modified and re-inspected. All cars that participate in the race events must display the inspection sticker. Race officials may re-inspect the cars at any time during the race and remove the inspection sticker if a car has been modified in a way that it fails to meet the approved car specifications.

## Car Specifications

All entered vehicles must be safe for contestants and spectators (e.g., no sharp edges, projectiles, etc.).

The dimensions for the Hydrogen Fuel Cell car cannot exceed (including fuel tanks):

- 20 cm. in width (7.87 in.)
- 40 cm. in length (15.75 in.)
- 20 cm in height (7.87 in.)

Each entry begins construction with:

- A hydrogen fuel cell, as provided by event organizers (no other fuel cell will be permitted in the Alternative Fuels Challenge (the fuel cell may not be modified in any way).
- A battery pack and wiring

The team may use any wiring system they choose; however, it is strongly recommended that these be paired up to the suggested input amperage of the fuel cell. If the input amps exceed 0.5 amps, the fuel cell may be destroyed.

Each team, on their own, will provide the additional parts needed for the construction of their car:

- wheels
- car body/chassis
- axles
- ring
- connectors
- gears

Individual decals may be affixed, and the body may be decorated at the team's discretion, but a 3 cm. square space must be left free on each side for the official vehicle decal number and inspection sticker.

The material for the body of the car can be any type of light material.

**Steering:** An eyelet must be attached to the bottom front of the car. An example of a possible design is illustrated below. A guide wire, 1 cm. (+/- .05 cm) from the surface of the track, will go through the attached eyelets on the car, serving as the steering mechanism, and keeping the car in its lane. Attach the eyelet to the bottom of your car near the front (or use two eyelets--one near the front and one near the rear). The guide wire will pass through the eyelet to keep your car in its lane.



The vehicle must be easily removed from the guide wire, without disconnecting the guide wire. This is the only allowable method of steering the car. Lane changing or crossing will result in disqualification.

**Warning:** Stubborn cars that don't track the wire are the biggest reason some cars do not win. Setting the car down straight isn't enough. Consider this carefully in your planning.

## Energy Source

The electricity needed for the electrolysis procedure must be provided by the battery pack. The battery packs are to be separate from the vehicle; the electrolysis is to be done in the charging area prior to the start of the race.

The only energy source permitted on the vehicle is the fuel cell with the hydrogen that was produced from the electrolysis procedure.

**Failure to meet these expectations will result in disqualification.**

## Car Performance Challenge

### Track Specifications

Lane Length: 10 meters

Lane Width: 50 centimeters per lane

Track Surface:

- As smooth as possible, flat and level or slightly downhill in the direction of the race (a large sheet of plastic, heavy paper or roll-roofing may be used to cover an uneven surface).
- Oriented if possible, so that prevailing winds are behind the vehicles as crosswinds can be a problem.
- Guide wire will be located in the center of each lane of the track and will not be more than 1.5 cm above the track surface.

### Drag Race Procedure:

1. **Charging Station:** The fuel cell must be charged at the charging station using a provided energy source, such as a dry cell battery, a DC power supply, or a solar panel.
2. **Race Day Electrolysis Procedure:** Before the scheduled race start, all teams must report to the designated charging station with their fuel cell car and solar cell. Distilled water will be provided at the charging station for the electrolysis process. There is no time limit on the electrolysis procedure—a team may report to the charging station as early or late as necessary; however, teams must be ready to start their race at the specified time. The only energy source permitted on the vehicle is the fuel cell with the hydrogen that it produced from the electrolysis procedure.
3. The drag race phase is made up of all registered competing teams. Drag race teams will be paired by drawing. If a team does not show up to race for their specific heat race when called, the team will be moved to the second chance bracket or eliminated. All teams will race a series of double-elimination head-to-head races to determine the first, second, and third place cars.
4. At race time, cars will be placed behind the starting line with all wheels in contact with the ground.
5. At the start of the race, the student at the starting line will connect the leads or close a switch of the fuel cell to the electric motor. The student must lift the drive wheels off the race course until the signal has been given to start the race.

6. An early or push start will result in disqualification or re-running the race. The race officials will determine if a student is disqualified or if the race must be rerun.
7. The race will start when the official signal is given. At the signal the drive wheels will be placed in contact with the race course and the car released. The time for the vehicle to complete the race will be recorded. Any vehicle that does not cross the finish line within 200 seconds will be recorded DNF and will move to the second chance bracket or eliminated.
8. One member of each team must wait at the finish line to catch the vehicle.
9. Team members may not accompany or touch the vehicle while it is racing on the track. Vehicles stalled on the track may be retrieved after the end of the race has been declared.
10. Vehicles that change or cross lanes will be disqualified (at the discretion of the race officials).
11. All decisions of the race officials are final.
12. Officials have the option to inspect cars prior to the final heat or at any time during/after the heats are completed.

#### The Starting Line (all race phases):

- The car will be placed behind the starting line.
- One team member (the starter) will be at the line with the car.
- The starting official will instruct both teams to begin the electrolysis procedure.
- When both teams have a full tank of hydrogen, the starting official will instruct them to disengage from the photovoltaic panel and prepare for the start of the race.
- At the start signal, this team member will start the car (flip the switch, make the connection, etc).
- Team members may not push a vehicle to start it.
- Team members may not accompany the vehicle in its lane during the race.

#### During the Heat:

- One team member may free the vehicle from the side or track imperfections should such problems occur. This freeing motion is a lateral movement only and may not include any forward movement.
- Team members may not push the vehicle or give any other physical assistance.
- Team members may not change the vehicle's mechanical or electrical characteristics (e.g. shift a transmission) after the start of the heat.

#### The Finish Line:

- One team member must be present at the finish line to stop the vehicle, preventing any damage to it.
- The vehicle must remain in its lane at the finish line until the order of the race vehicles has been established.

**Failure to meet these expectations will result in disqualification.**

## Car Design Challenge

Each team is encouraged, but not required, to compete in the Car Design Challenge. All cars however will be inspected for compliance with construction specifications. Cars entered in the Car Design Challenge will be displayed on a table for judging. Judges will interview the students and inspect the cars. Scoring will be determined using the Car Design Rubric (Attachment A). Innovation, technology and craftsmanship will all be considered.

## Oral Presentation Challenge

Each team is encouraged, but not required, to compete in the Oral Presentation Challenge. **The presentation topic is “What impacts, positive or negative, might hydrogen fuel technology have on our society.”** This is the chance for the teams to showcase their expertise, knowledge and talents beyond the design and performance of their car. The “live” team performance is to be **5 - 10 minutes in length** and can be in any format that the team chooses. Please remember that at least 2 of your team members may in a different location racing your car – so plan your presentation accordingly. Scoring will be determined using the Oral Presentation Rubric (Attachment B). Examples below are not meant to be exclusive – students are encouraged to be creative. Examples might include:

- Skit
- Slide Show
- Song

NOTE: Prepared videos/movies are NOT ALLOWED – students must perform “live” in front of the judges.

## Essay Challenge

Each team is encouraged, but not required, to compete in the Essay Challenge. **The essay topic is “What impacts, positive or negative, might hydrogen fuel technology have on our society.”** This is a chance for teams to showcase their expertise, knowledge and talents beyond the design and performance of their car. The essay should be **500-700 words** in length and is **due on April 1, 2008**. Scoring will be determined using the Essay Rubric (Attachment C). Essays should be **emailed or faxed to Amy Tapia, [astapia@sandia.gov](mailto:astapia@sandia.gov) or 284-5210.**

## Race Day Logistics

Directions:

- Dress in layers – we will be inside, but the buildings are not heated.
- Bring water??
- Students and teachers will receive a lunch ticket (complimentary)

- Food can be brought in to the competition. Food will also be available for purchase by parents, siblings, guests and observers.
- An awards ceremony will follow the completion of all Challenges. All student participants will receive a participation medal. Awards will be given to 1st, 2nd and 3<sup>rd</sup> place teams in each Challenge and Overall.

## Contacts

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